

**What is claimed is:**

- 1        1.    A glass molding die, comprising:  
2        a substrate;  
3        a first noble metal layer overlying the substrate;  
4        a second noble metal layer overlying the first noble  
5           metal layer;  
6        a carbon-containing third noble metal layer overlying  
7           the second noble metal layer; and  
8        a DLC (diamond-like carbon) passivation film overlying  
9           the third noble metal layer.
- 1        2.    The molding die as claimed in claim 1, wherein the  
2        substrate comprises tungsten carbide.
- 1        3.    The molding die as claimed in claim 1, wherein the  
2        first noble metal layer comprises Ni-containing Ir-Re alloy.
- 1        4.    The molding die as claimed in claim 1, wherein the  
2        thickness of first noble metal layer comprises about 0.3 to  
3        0.6 $\mu$ m.
- 1        5.    The molding die as claimed in claim 1, wherein the  
2        second noble metal layer comprises Ir-Re alloy.
- 1        6.    The molding die as claimed in claim 1, wherein the  
2        thickness of second noble metal layer is about 0.3 to 0.6 $\mu$ m.
- 1        7.    The molding die as claimed in claim 1, wherein the  
2        thickness of third intermediate layer is about 0.01 to  
3        0.05 $\mu$ m.

1        8.    The molding die as claimed in claim 1, wherein the  
2    third noble metal layer comprises carbon-containing Ir-Re  
3    alloy with C, Ir, and Re atoms therein approximately  
4    arranged in superlattice.

1        9.    The molding die as claimed in claim 8, wherein  
2    carbon concentration in the third noble metal layer is  
3    approximately 20% or more.

1        10.   The molding die as claimed in claim 1, wherein the  
2    third noble metal layer comprises carburized Ir-Re alloy.

1        11.   The molding die as claimed in claim 10, wherein  
2    carbon concentration in the carburized surface of the third  
3    noble metal layer is approximately 20% or more.

1        12.   The molding die as claimed in claim 1, wherein the  
2    thickness of passivation film is about 0.01 to 0.3 $\mu$ m.

1        13.   The molding die as claimed in claim 1, wherein the  
2    passivation film comprises a molding surface.

1        14.   The molding die as claimed in claim 1, wherein  
2    when the DLC passivation film deteriorates, the deteriorated  
3    DLC passivation film and third noble metal layer are removed  
4    by oxygen plasma, followed by sequential formation of the  
5    third noble layer and DLC passivation film overlying the  
6    second noble metal layer.

1        15.   A renewing method for a glass molding die,  
2    comprising:

3 providing a used glass molding die comprising a  
4 substrate, a first noble metal layer overlying  
5 the substrate, a second noble metal layer  
6 overlying the first noble layer metal, a carbon-  
7 containing third noble metal layer overlying the  
8 second noble metal layer, and a DLC passivation  
9 film overlying the third noble metal layer;  
10 removing the passivation film and third noble metal  
11 layer using oxygen plasma;  
12 grinding and polishing the molding die to completely  
13 remove the third noble metal layer;  
14 cleaning the polished molding die;  
15 forming a fourth noble metal layer overlying the second  
16 noble metal layer; and  
17 forming a second passivation film comprising  
18 approximately the same material as the  
19 passivation film overlying the fourth noble metal  
20 layer.

1 16. The method as claimed in claim 15, wherein the  
2 substrate comprises tungsten carbide.

1 17. The method as claimed in claim 1, wherein the  
2 first noble metal layer comprises Ni-containing Ir-Re alloy.

1 18. The method as claimed in claim 15, wherein the  
2 thickness of first noble metal layer comprises about 0.3 to  
3 0.6 $\mu$ m.

1 19. The method as claimed in claim 15, wherein the  
2 second noble metal layer comprises Ir-Re alloy.

1        20. The method as claimed in claim 15, wherein the  
2 thickness of second noble metal layer is about 0.3 to 0.6 $\mu$ m.

1        21. The method as claimed in claim 1, wherein the  
2 thickness of third intermediate layer is about 0.01 to  
3 0.05 $\mu$ m.

1        22. The method as claimed in claim 15, wherein the  
2 third noble metal layer comprises carbon-containing Ir-Re  
3 alloy with C, Ir, and Re atoms therein approximately  
4 arranged as superlattice.

1        23. The method as claimed in claim 15, wherein the  
2 third noble metal layer comprises carburized Ir-Re alloy.

1        24. The method as claimed in claim 15, wherein the  
2 fourth noble metal layer comprises approximately the same  
3 material as the third noble metal layer.

1        25. The method as claimed in claim 15, wherein the  
2 fourth noble metal layer comprises carbon-containing Ir-Re  
3 alloy with C, Ir, and Re atoms therein approximately  
4 arranged as superlattice.

1        26. The method as claimed in claim 25, further  
2 comprising forming the fourth noble metal layer using co-  
3 sputtering with multiple targets.

1        27. The method as claimed in claim 25, wherein carbon  
2 concentration in the fourth noble metal layer is  
3 approximately 20% or more.

1        28. The method as claimed in claim 15, wherein the  
2 fourth noble metal layer comprises carburized Ir-Re alloy.

1        29. The method as claimed in claim 28, wherein forming  
2 the fourth noble metal layer further comprises:

3        forming a Ir-Re alloy layer overlying the second noble  
4 metal layer; and

5        implanting carbon ions into a surface of the Ir-Re  
6 alloy layer, thereby carburizing the Ir-Re alloy  
7 layer.

1        30. The method as claimed in claim 28, wherein carbon  
2 concentration in the carburized surface of the fourth noble  
3 metal layer is approximately 20% or more.

1        31. The method as claimed in claim 15, wherein the  
2 thickness of second passivation film is about 0.01 to 0.3 $\mu$ m.

1        32. The method as claimed in claim 1, wherein the  
2 second passivation film has a molding surface.